

## CLAIMS

What is claimed is:

1. A membrane electrode assembly, comprising:

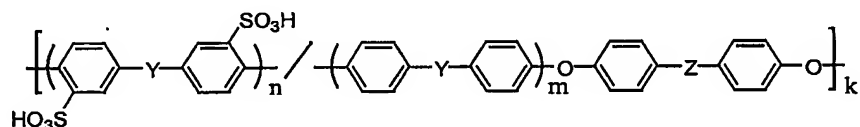
an anode;

a cathode; and

a proton exchange membrane positioned between the anode and cathode,

wherein at least one of the anode, the cathode, and the proton exchange

membrane comprises a sulfonated copolymer having the following chemical



structure:

wherein;

$n/m+m$  ranges from about 0.001 to about 1;

Y may be  $-\text{S}-$ ,  $\text{S}(\text{O})$ ,  $\text{S}(\text{O})_2$ ,  $\text{C}(\text{O})$ , or  $\text{P}(\text{O})(\text{C}_6\text{H}_5)$ , and combination thereof;

and

Z may be a direct carbon – carbon single bond,  $\text{C}(\text{CH}_3)_2$ ,  $\text{C}(\text{CF}_3)_2$ ,

$\text{C}(\text{CF}_3)(\text{C}_6\text{H}_5)$ ,  $\text{C}(\text{O})$ ,  $\text{S}(\text{O})_2$ , or  $\text{P}(\text{O})(\text{C}_6\text{H}_5)$ .

2. The membrane electrode assembly of claim 1, wherein at least one of

the anode, the cathode, and the proton exchange membrane comprises an inorganic

heteropoly acid.

3. The membrane electrode assembly of claim 2, wherein the inorganic heteropoly acid may be phosphotungstic acid, phosphomolybdic acid, zirconium hydrogen phosphate, or a zirconium containing heteropoly acid.

5 4. The membrane electrode assembly of claim 2 wherein the inorganic heteropolyic ranges from about 0.01 to about 60% by weight.

5. The membrane electrode assembly of claim 1 wherein  $n/n+m$  ranges from about 0.3 to about 0.6.

10 6. The membrane electrode assembly of claim 1, wherein Y is  $S(O)_2$  and Z is a direct carbon-carbon single bond.

7. The membrane electrode assembly of claim 1, wherein the proton  
15 exchange membrane and at least one of the anode and cathode comprise the same sulfonated copolymer.

8. A membrane electrode assembly, comprising:  
an anode;  
20 a cathode; and  
a proton exchange membrane positioned between the anode and cathode,  
wherein the proton exchange membrane and at least one of the anode and the cathode comprises a sulfonated polysulfone having at least one sulfonate moiety on a deactivated aromatic ring adjacent to a sulfone functional group of a polysulfone.

9. An electrode casting solution comprising:

a sulfonated polymer dispersed in a solvent in an amount up to about 20% by weight, wherein the solvent is adapted to cast the sulfonated polymer on a substrate and is adapted to substantially maintain the integrity of the substrate.

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10. The electrode casting solution of claim 9, wherein the solvent is a combination of one or more solvents selected from the group of water, isopropyl alcohol, acetone, N,N-dimethylacetamide, 1-methyl-2-pyrrolidinone, 1,3-dioxolane, 2-methoxy ethanol, or benzyl alcohol.

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11. The electrode casting solution of claim 9, wherein the solvent includes N,N-dimethylacetamide or 1-methyl-2-pyrrolidinone and a combination of two or more solvents selected from the group of water, isopropyl alcohol, acetone, 1,3-dioxolane, 2-methoxy ethanol, or benzyl alcohol.

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12. The electrode casting solution of claim 9, further comprising a water retention additive.

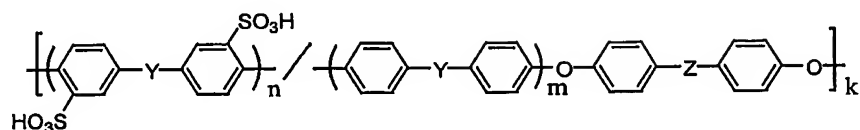
13. The electrode casting solution of claim 12, wherein the water retention additive is phosphotungstic acid, phosphomolybdic acid, zirconium hydrogen phosphate, or a zirconium containing heteropoly acid.

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14. The electrode casting solution of claim 9, further comprising a catalyst dispersed in the casting solution.

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15. The electrode casting solution of claim 9, wherein the sulfonated polymer has the following chemical structure:



wherein;

5  $n/m+m$  ranges from about 0.001 to about 1;

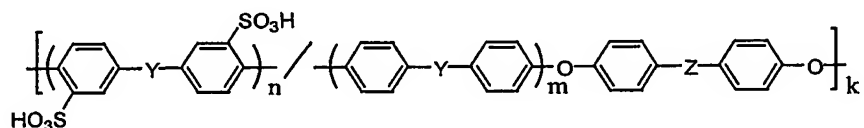
Y may be  $-S-$ ,  $S(O)$ ,  $S(O)_2$ ,  $C(O)$ , or  $P(O)(C_6H_5)$ , and combination thereof;

and

Z may be a direct carbon – carbon single bond,  $C(CH_3)_2$ ,  $C(CF_3)_2$ ,  $C(CF_3)(C_6H_5)$ ,  $C(O)$ ,  $S(O)_2$ , or  $P(O)(C_6H_5)$ .

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16. An electrode for a fuel cell, comprising a sulfonated copolymer having the following chemical structure:



wherein;

15  $n/m+m$  ranges from about 0.001 to about 1;

Y may be  $-S-$ ,  $S(O)$ ,  $S(O)_2$ ,  $C(O)$ , or  $P(O)(C_6H_5)$ , and combination thereof;

and

Z may be a direct carbon – carbon single bond,  $C(CH_3)_2$ ,  $C(CF_3)_2$ ,  $C(CF_3)(C_6H_5)$ ,  $C(O)$ ,  $S(O)_2$ , or  $P(O)(C_6H_5)$ .

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17. The electrode of claim 16, further comprising phosphotungstic acid, phosphomolybdic acid, zirconium hydrogen phosphate, or a zirconium containing heteropoly acid.

5 18. The electrode of claim 16, further comprising a catalyst.

19. An electrode for a fuel cell, comprising a sulfonated polysulfone having at least one sulfonate moiety on a deactivated aromatic ring adjacent to a sulfone functional group of a polysulfone.

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20. The electrode of claim 19, further comprising phosphotungstic acid, phosphomolybdic acid, zirconium hydrogen phosphate, or a zirconium containing heteropoly acid.

15 21. The electrode of claim 19, further comprising a catalyst.